

[01] **ADAPTABLE COMPUTER CARD I/O CONNECTION**

[02] **FIELD OF THE INVENTION**

[03] The present invention relates to a method for providing connector options for different connector types, and in particular for different form factor I/O card solutions, such as NLX and ATX. The invention also relates to a computer motherboard mounted card which is to be provided with a variable type of I/O connector, such as in the case of a graphics card.

[04] **BACKGROUND OF THE INVENTION**

[05] Motherboard mounted computer graphics cards are known which provide dual display output. When made for two displays, also known as a dual-head mode, the graphics card can operate with the first display or head either as a digital flat panel output (DVI) or a standard analog monitor output (HD-15). The second head can be a standard analog monitor output RGB (HD-15) or television (Mini-din or RCA).

[06] Since it is not mechanically possible to fit all five connectors in the I/O bracket opening (DVI, HD-15, HD15, Mini-Din, RCA), choosing which connections will make up the dual-head configuration must be made. Thus, if it is not possible to put all five connectors on one I/O card, multiple variations of cards must be designed.

[07] In an ATX form factor, one would have to design four different I/O cards to support all modes of operation of dual head product capabilities. These four variations are;

[08] 1) Digital flat panel (DVI) and analog monitor (HD-15).

[09] 2) Digital flat panel (DVI) and video (Mini-din and RCA).

[10] 3) Analog monitor (HD-15) and analog monitor (HD-15).

[11] 4) Analog monitor (HD-15) and video (Min-din and RCA).

[12] One attempt to reduce the number of I/O card configurations by half, is to use a break-out cable as an adapter. This adapter converts an HD-15 connector into two video

connectors, the mini-DIN4 and RCA. Thus, for the second head, all I/O cards would have an HD-15 connector, and with the help of this break-out cable, either an analog monitor or TV/VCR can be connected. However, even with this break-out cable, two cards still need to be designed; card 1 and card 3 described above.

[13] To reduce further the number of boards to design from 2 to 1, one can provide only one board with a DVI connector and provide a DVI to HD-15 adapter. However, the combined cost of the adapter and the DVI board connector is expensive.

[14] In addition to the connector combination needs for the ATX form factor dual-head graphics card, a similar set of combinations for the NLX form factor is required. The NLX was designed to improve upon today's low form factors and to adapt to new market trends and PC technologies. The NLX form factor is an attempt at incorporating flexibility to accommodate the best designs for current and future PC's.

[15] Since the NLX motherboard specification accommodates the use of double width connectors across half of the rear I/O and single high across the whole maximum board width, the I/O card must be designed with this form factor in mind. Therefore, the combinations of (DVI and HD-15), (HD-15 and HD-15), (HD-15 and Mini-din and RCA), and (DVI and Mini-din and RCA) cannot be connected by mounting directly above each other on the I/O card as is possible with the ATX form factor. Instead, a special module must be designed that attaches to the baseboard and has the second connector mounted in a double width connector bracket. This is the standard solution for NLX form factor cards having dual I/O connectors. In an NLX form factor, one would have to design four different I/O cards to support all modes of operation of dual head product capabilities. These four variations are:

[16] 1) Digital flat panel (DVI).

[17] 2) Analog monitor (HD-15).

[18] 3) Analog monitor (HD-15) module.

[19] 4) Video (Mini-din and RCA) module.

- [20] In order to achieve the same dual head product capabilities as with the ATX form factor the four variations outlined above must be combined in the following way:
- [21] 1) Digital flat panel (DVI) with analog monitor (HD-15) module.
- [22] 2) Digital flat panel (DVI) with video (Mini-din and RCA) module.
- [23] 3) Analog monitor (HD-15) with analog monitor (HD-15) module.
- [24] 4) Analog monitor (HD-15) with video (Mini-din and RCA) module.
- [25] Although the NLX form factor changes have resulted in a reduction in overall system level cost for the computer, there has been an increase in cost for the I/O card manufacturers as they have to design specific I/O cards to fit the NLX form factor. If the same options in the NLX form factor as in the ATX form factor were to be provided, eight I/O cards would have to be designed.

[26] **SUMMARY OF THE INVENTION**

[27] Therefore, it is an object of the invention to provide a way of connecting combinations and permutations of dual-head connector options for NLX and ATX form factor I/O.

[28] The object of the present invention relates to deriving a way of reducing the number of I/O cards required from eight cards to two cards; one card is a base and the other card is a module. For example, instead of having to design one ATX form factor card with a (DVI and HD-15) connector, plus one ATX form factor card with a (HD-15 and HD-15) connector, plus one ATX form factor with a (DVI and SVHS with mini-din and RCA) connector, plus one ATX form factor card with a (HD-15 and SVHS with mini-din and RCA) connector, plus one NLX form factor card with a (DVI) connector, plus one NLX form factor card with a (HD-15) connector, plus one (HD-15) module, plus one (SVHS with mini-din and RCA) module, the way in which the card is designed requires that only one NLX form factor card and one module is manufactured. This approach brings about an advancement in inventory management and lowers PCB cost.

[29] This novel approach to managing the possible combinations of dual-head connector solutions is achieved by designing a "long body", high density, right angle, PCB D-

Subminiature (HD-15) connector that clears the NLX I/O card cutout located at the lower front section of the card. In this case, a change to the footprint architecture must be made to accommodate the new "long body" HD-15 connector. This new footprint architecture along with the custom designed HD-15 connector serves as the catalyst of this design idea. Another object of this invention is changing the footprint architecture on the upper front section of the NLX I/O card, enabling it to clear the DVI footprint architecture. The DVI footprint architecture is located close to the edge of the card and is positioned in front of the newly positioned HD-15 footprint architecture. The result is one NLX form factor card that has one DVI and two HD-15 footprints.

[30] Therefore, by combining this new NLX form factor card that uses the new "long-body" HD-15 footprint architecture with a new "long body" I/O module footprint architecture, a wide range of dual-head display possibilities can be achieved. Simultaneous output either to (two RGB monitors), to (an RGB monitor and a television set), to (an RGB monitor and a digital flat panel) or to (a digital flat panel and TV set) can be achieved with only one I/O card and one I/O module.

[31] Another object of the present invention involves an incremental approach to reducing the number of I/O cards within similar, dissimilar, and a combination thereof of I/O card form factors which ultimately lead to the primary objective of the present invention in optimizing the reduction of I/O cards required to be manufactured.

[32] The four ATX form factor card configurations consist of one card with (DVI and HD-15 footprints), one card with (two HD-15 footprints), one card with (one DVI and one SVHS with mini-din, and one RCA footprints), and one card with (one HD-15 and one SVHS with mini-din, and one RCA footprint). The possible combinations derived from the four ATX form factor card connections outline above can be reduced to one card with (one DVI, two long body HD-15, one Mini-din, and one RCA footprint).

[33] The two NLX form factor card configurations consist of one card with (one DVI footprint) and one card with (one HD-15 footprint). The possible combinations derived from these two NLX form factor card configurations can be reduced to one card with (one DVI footprint) and (one long body HD-15 footprint).

- [34] The two module configurations that consist of one HD-15 module and one Mini-din and RCA module can be reduced to one module that includes the two configurations.
- [35] Reducing the number of cards required to its optimal level is achieved by combining the result of the one ATX form factor card solution as outlined above, the result of the one card NLX form factor solution as outlined above, and the result of one module solution outlined above. The end result is the need to manufacture only one NLX form factor I/O card that has one DVI footprint and two long body HD-15 footprints and one module that has one Mini-din, one RCA, and one long body HD-15 footprint.
- [36] According to the invention, there is provided a computer motherboard-mounted card having at least one I/O connector, the card comprising: two footprints positioned one behind the other for accommodating two different output types; and one right-angle, vertical edge, I/O connector mounted with pins in a selected one of the two footprints.
- [37] Another benefit of the invention is that it allows users to reconfigure their systems to use different monitors in different situations or as needs change. The breakout cables, adapters, and/or modules provide much flexibility to the user.
- [38] The invention also provides a method of manufacturing a motherboard-mounted computer card having at least one I/O connector, the method comprising: providing at least two footprints positioned on the computer card for accommodating two different output types; providing a plurality of different right-angle, vertical edge, I/O connectors having mounting pins receivable by a selected one of the at least two footprints, the I/O connectors being adapted to reach the selected one of the footprints while providing a vertical edge I/O connector substantially at a common position; and selectively mounting one of the plurality of I/O connectors to one of the footprints.
- [39] **BRIEF DESCRIPTION OF THE DRAWINGS**
- [40] A better understanding of the invention will be obtained by reference to the detailed description below in conjunction with the following drawings, in which:

- [41] FIG.1 is a plan view of an ATX form factor I/O card showing a DVI and HD-15 footprint according to the prior art.
- [42] FIG.2 is a plan view of an ATX form factor I/O card showing two HD-15 footprints according to the prior art.
- [43] FIG.3 is a plan view of an ATX form factor I/O card showing a DVI, Mini-din, and RCA footprint according to the prior art.
- [44] FIG.4 is a plan view of an ATX form factor I/O card showing a HD-15, Mini-din, and RCA footprint according to the prior art.
- [45] FIG.5 is a plan view of an ATX form factor I/O card showing a DVI, SVHS with Mini-din, RCA, and two long body HD-15 footprints.
- [46] FIG.6 is a plan view of an NLX form factor I/O card showing a DVI footprint according to prior art.
- [47] FIG.7 is a plan view of an NLX form factor I/O card showing a HD-15 footprint according to prior art.
- [48] FIG.8 is a plan view of an NLX form factor card showing a DVI and long body HD-15 footprint.
- [49] FIG.9 is a plan view of a module showing a HD-15 footprint according to prior art.
- [50] FIG.10 is a plan view of a module showing a Mini-din, and RCA footprint according to prior art.
- [51] FIG.11 is a plan view of a module showing a Mini-din, RCA, and long body HD-15 footprint.

[52] FIG.12 is a plan view of an NLX form factor card showing one DVI footprint and two long body HD-15 footprints.

[53] FIG.13 is a plan view of a "long-body" HD-15 connector showing top, front, and side views.

[54] FIG.14 is a 2-Dimensional side view of an NLX form factor I/O card plugged into an AGP slot of an NLX form factor motherboard.

[55] **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[56] References will now be in detail to the preferred embodiments of the invention. While the present invention has been described in with reference to the specific embodiments, the description is illustrative of the invention and is not to be construed as limiting the invention. Various modifications to the present invention can be made to the preferred embodiments by those skilled in the art without departing from the essential methodology and scope of the invention as defined herein.

[57] For example, a long body DVI connector, or a long body TV out (composite plus Y/C video) connector could be used to provide alternative dual head ATX/NLX PCB designs with similar advantages to the preferred embodiment.

[58] FIG. 1 illustrates a dual-head footprint solution on an ATX form factor card 2. The footprint 1 at the upper front section of card 2 is for a DVI connection. The footprint 3 at the lower front section of card 2 is for a HD-15 connection. The DVI connector (not shown) has pins soldered to the contacts in footprint 1, and for mechanically mounting the connector to the board 2, three through holes 12a, 12b and 12c are provided for receiving mounting members of the connector. The HD-15 connector (not shown) likewise has mounting members for fitting into through holes 12d and 12e, while the pins of the HD-15 connector are soldered into footprint 3.

- [59] FIG.2 illustrates a dual-head footprint solution on an ATX form factor card 5. The footprint 4 at the upper front section of card 5 is for a HD-15 connection. The footprint 3 at the lower front section of card 5 is also for a HD-15 connection.
- [60] FIG.3 illustrates three possible combinations of footprints on an ATX form factor card 6. The footprint 1 at the upper front section of card 6 is for a DVI connection. The two footprints at the lower front section are for a Mini-din 7 and RCA 8 footprint.
- [61] FIG.4 illustrates three possible combinations of footprints on an ATX form factor card 9. The footprint 4 at the upper front section of card 9 is for an HD-15 connection. The two footprints at the lower front section are for a Mini-din 7 and RCA 8 footprint.
- [62] FIG.5 illustrates five possible combinations of footprints on an ATX form factor I/O card 11. The footprint 1 at the upper front section of card 11 is for a DVI connection. The footprint 7 at the lower front section of card 11 is for a Mini-din connection. The footprint located directly below footprint 7 is for an RCA connection 8. In the upper front section located horizontally adjacent to footprint 1 is a long body HD-15 footprint 10. Vertically below footprint 10 is the second long body HD-15 footprint 12.
- [63] FIG.6 illustrates a single-head footprint on an NLX form factor card 13. The footprint 1 at the upper front section of card 13 is for a DVI connection 1.
- [64] FIG. 7 illustrates a single-head footprint on an NLX form factor card 14. The footprint 4 at the upper front section of card 14 is for a HD-15 connection.
- [65] FIG.8 illustrates two possible combinations of footprints on an NLX form factor I/O card 15. The footprint at the upper front section is for a DVI connection 1 and the footprint horizontally opposite footprint 1 in the upper section is for a long body HD-15 connection 10.

- [66] FIG.9 illustrates a single head module 17. The footprint 16 at the front section is for a HD-15 connection.
- [67] FIG.10 illustrates two possible combinations of footprints on a module 20. The footprint 18 at the upper front section is for a Mini-din connection and the footprint at the lower front section is for an RCA.
- [68] FIG.11 illustrates three possible combinations of footprints on a module 21. The footprint 18 at the upper front section is for a Mini-din connection and the footprint at the lower front section is for an RCA connection 19. The footprint horizontally opposite footprints 18,19 is for a long body HD-15 connection 22.
- [69] FIG.12 illustrates three possible combinations of footprints on an NLX form factor card 23. The footprint 1 at the upper front section of card 23 is for a DVI connection. The second footprint 10 located next to footprint 1 at the upper front section is for a long body HD-15 connection 10. The footprint 12 is located at the lower front section of the card and is perpendicular to footprint 10 above it.
- [70] FIG.13 illustrates a plan view of a "long-body" HD-15 connector 24. With a length of 1.580" (40.13mm) the HD-15 connector 24 fits the HD-15 footprint 10 and HD-15 footprint 12. The special size of connector 24 and corresponding footprints 10 and 12 allow for connecting combinations and permutations of dual-head connector options for NLX and ATX form factor solutions. The connector 24 has mounting members 24a and 24b, and 24c which fit through holes 10a, 10b and 10c (Fig.12) for upper front section fitting and 12a, 12b and 12c (Fig.12) respectively for lower front section settings and have bendable legs for fastening connector 24 to the board 23. The third member 24c provides stability for the mounting of connector 24 and mounts on card 23 above the cut-out 23a when mounted in the lower front section of the I/O card. In this way, the card 23 can be used for ATX form factor computers with dual connectors mounted on the I/O card one above the other.

- [71] FIG.14 illustrates a 2-dimensional side view of an NLX form factor I/O card 23 plugged into an AGP slot of an NLX form factor motherboard 24. The I/O card 23 is designed with cut-out 23a to enable it to fit over the double-high connectors 25 mounted on the NLX motherboard.